

WHAT IS CLAIMED IS

1. A semiconductor device having a storage node capacitor structure, the device comprising:

5       a storage node which has a vertical surface extending in the direction perpendicular to the surface of a semiconductor substrate; and

10       a dielectric film for tilt prevention purposes which is brought into close contact with the side surface of the vertical surface and which prevents the vertical surface from tilting.

15       2. The semiconductor device as defined in Claim 1, wherein the storage node comprises one or more storage nodes, and the dielectric film is interposed among the vertical surfaces of the plurality of storage nodes.

20       3. The semiconductor device as defined in Claim 1, wherein the storage node has a horizontal surface which extends along the surface of the semiconductor substrate and which is brought into conduction with the vertical surface; and

      the end face of the dielectric film provided in the vicinity of the tip end of the storage node is positioned closer to the tip end than the horizontal surface is.

25       4. The semiconductor device as defined in Claim 1, wherein the vertical surface is formed into the shape of a cylinder, and the dielectric film is formed so as to surround the vertical surface.

30       5. The semiconductor device as defined in Claim 1, wherein the dielectric film is an oxide film.

6. The semiconductor device as defined in Claim 1, wherein the dielectric film is a nitride film.

7. The semiconductor device as defined in Claim 1, wherein the dielectric film includes both an oxide film and a nitride film.

8. A method of manufacturing a semiconductor device having a storage node and a dielectric film for tilt prevention purposes, wherein the storage node has a vertical surface which extends in the direction perpendicular to the surface of a semiconductor substrate, and wherein the dielectric film is brought into close contact with the side surface of the vertical surface and prevents the vertical surface from tilting, the method comprising the steps of:

forming in the surface of the semiconductor substrate a cylindrical space for use in forming the vertical surface through use of a dielectric film;

forming in the cylindrical space the storage node having the vertical surface; and

forming a dielectric film for preventing purpose which prevents the vertical surface from tilting by utilization of the dielectric film after formation of the vertical surface.

9. The method of manufacturing a semiconductor device as defined in Claim 8, wherein:

in the step for forming the storage node, there is formed a storage node having a horizontal surface which extends along the surface of the semiconductor substrate and a cylindrical vertical surface surrounding the horizontal surface; and

in the step for forming the dielectric film, there is formed a dielectric film for tilt prevention purposes whose tip end provided in the vicinity of the tip end of the storage node

is positioned closer to the tip end than the horizontal surface is.

5        10. The method of manufacturing a semiconductor device as defined in Claim 8, wherein the dielectric film for tilt prevention purposes is an oxide film.

10       11. The method of manufacturing a semiconductor device as defined in Claim 8, wherein the dielectric film for tilt prevention purposes is a nitride film.

12. The method of manufacturing a semiconductor device as defined in Claim 8, wherein the step for forming the cylindrical space comprises the steps of:

15       forming signal lines on the surface of the semiconductor substrate;

      forming a first dielectric layer from a first dielectric material so as to cover the surface of the signal lines;

20       forming a second dielectric layer from a second dielectric material, which differs from the first dielectric material, so as to cover the first dielectric film;

      forming a third dielectric layer from a third dielectric material, which differs from the second dielectric material, so as to cover the second dielectric film;

25       etching an area where the cylindrical space is to be formed, by means of a measure suitable for removing the third dielectric material and for conserving the second dielectric material; and

30       etching an area where the cylindrical space is to be formed, by means of a measure suitable for removing the second dielectric material and for conserving the first and third dielectric materials.

13. The method of manufacturing a semiconductor device as defined in Claim 12, wherein the second dielectric layer has a thickness required by the dielectric film for tilt prevention purposes; and wherein the dielectric film for tilt prevention purposes is formed by removal of the third dielectric layer remaining on the second dielectric layer after formation of the vertical surface.

14. The method of manufacturing a semiconductor device as defined in Claim 12, wherein the first and third dielectric films are oxide films, and the second dielectric film is a nitride film.

15. A method of manufacturing a semiconductor device including a storage node and a dielectric film for tilt prevention purposes, wherein the storage node has a vertical surface extends in the direction perpendicular to the surface of a semiconductor substrate and a horizontal surface extending along the surface of the semiconductor substrate, and wherein the dielectric film is brought into close contact with the side surface of the vertical surface and prevents the vertical surface from tilting, the method comprising the steps of:

forming the horizontal surface on the surface of the semiconductor substrate;

forming a fourth dielectric layer having a given thickness from a fourth dielectric material on the horizontal surface;

forming the vertical surface while being brought into close contact with the horizontal surface and the outer circumferential surface of the fourth dielectric layer;

forming a fifth dielectric layer around the vertical surface from a fifth dielectric material differing from the fourth dielectric material; and

eliminating the fourth dielectric layer by means of etching through use of a measure suitable for eliminating the fourth dielectric material and for conserving the fifth dielectric material.

5

16. The method of manufacturing a semiconductor device as defined in Claim 15, further comprising a step of etching the fifth dielectric layer until the thickness thereof is equal to a given length so that the tip end of the vertical surface is out from the surface of the fifth dielectric layer by only a given length.

10

17. The method of manufacturing a semiconductor device as defined in Claim 15, wherein the fourth dielectric film is a nitride film, and the fifth dielectric film is an oxide film.

15